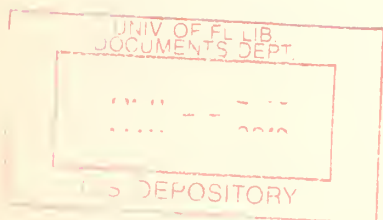


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FOREST PRODUCTS AND DEFENSE

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FOREST PRODUCTS AND DEFENSE¹

By

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National defense means more than a big army, a two-ocean navy, and a skyfull of airplanes -- it means an adequate supply of natural resources, of which timber and forest products are outstandingly important.

A nation that has within its boundaries a bountiful supply of forest products has an enormous advantage. Fortunately, the timber supplies of the United States, except for certain special purposes requiring relatively minor quantities, seem ample to meet our forest products needs of the present emergency, and doubtless for future emergencies if we will carry out sound forest practices with our abundant forest lands.

War intensifies most peacetime uses of wood in addition to bringing forth many specific military and naval uses. The combatants in the present European war are using a veritable host of diversified forest products, some of which are age-old whereas others are the products of modern research. They include such things as wood for cantonments, barracks, houses, factories, hangars, scaffolding, boats, wharves, bridges, pontoons, railway ties, telephone poles, mine props, antitank barriers, shoring, shipping containers, and air-raid shelters; plywood for airplanes, blackout shutters, prefabricated housing, concrete forms, ship patterns, assault boats, ship interiors, truck bodies, and army lockers; fuel for gasogenes, trucks, tractors, stoves, boilers, and mobile kitchens; pulp and paper for surgical dressings, boxes, cartridge wrappers, building papers, pasteboards, gas-mask filters, printing, and propaganda distribution; synthetic wood fibers, such as in rayon, artificial wool and cotton, for clothing, parachutes², and other textiles; wood cellulose for explosives; wood charcoal for gas masks and steel production³; rosin for shrapnel and varnishes, turpentine for flame throwers, paint, and varnishes; cellulose acetate for photographic film, shatterproof glass, airplane dopes, lacquer, cement, and molded articles; wood flour for dynamite; wood bark for insulation, tannin, and dyestuffs⁴; and rubber for all peacetime uses in addition to tires, tank-treads⁴, and other standard army and navy uses.

¹Presented before the Annual Conservation Conference at Hartford, Conn., Feb. 6, 1941

²Textile World, p. 87, Sept. 1940.

³Wood, p. 209, Sept. 1940.

⁴Fortune, p. 61, Sept. 1940.

In the last war the United States had 20,000 Americans scattered throughout France operating sawmills and cutting forests for bridges, railways, and other war uses. As high as 30,000 trees were used daily by a single French army corps. Simultaneously the Forest Products Laboratory was expanded six-fold and operated 24 hours a day keeping abreast of the various technical wood problems of the Army, Navy, and other defense organizations.

Discoveries in new and wider uses of wood have gone so far today that it is essential to our national defense to keep abreast of them. The Germans, in their 4-year plan under General Goering, classed forest products as the second most important natural resource of the country and strenuous efforts were made to use every scrap of wood to aid the military and defense situation. Because of the shortage of food in Germany and also because of the high cost of crude oil and gasoline, attention was given to the production of sugar and alcohol from wood. Raw wood sugar can be used for animal food, and with refinement for humans. It may be fermented with yeast to form ethyl or "grain" alcohol to replace gasoline. A shortage of wool and the fact that there is no domestic cotton, directed the Germans to the production of "wood-wool" and "wood-cotton." A certain percentage of wood-wool is required in all German uniforms. Research work in Europe has also brought steady progress in developing a wood-gas generator, so that for the past several years busses, trucks, and even pleasure cars have been powered by this means.

Fundamentally there is nothing substantially new in these technical developments that the United States is not familiar with but at that time and even now they are not economically practical in the United States. However, should unforeseen disaster befall us the techniques for producing such things are well known and wood could be used over here for such purposes.

With this sketchy perspective as a background, and recognizing that technological advances with wood and other products have brought about many changes in our present forest products war needs from those of the last war, there are nevertheless great numbers of diversified uses requiring forest products and many technical problems for their improvement confronting us today. I will describe a few of the more important, either from the standpoint of quantity or of technical problems inherent to their use.

Lumber and Structural Material

If we consider national defense in terms of an American army of 1-1/2 million men by July 1941,⁵ we think at once of cantonments and training centers; and these mean not only barracks but recreation halls, theaters, hospitals, mess halls, warehouses, post exchanges, and other buildings -- all of which require enormous quantities of forest products.

⁵Eng. News Rec., p. 38, Oct. 1940.

Thus, a score of modern towns to house our soldiers are being erected at various strategic points throughout the United States. With few exceptions, the structures are being built of wood, this material lending itself to greatest speed in procurement and labor supply. The buildings are well planned for the health and comfort of the men and are superior to the cantonment construction of World War days. The structures are adapted to three temperature zones.⁶ Some in the deep South consist of framed tents but the majority located elsewhere are of standard wood frame-and-sheathing construction.

An idea of the magnitude of this undertaking may be had from the fact that the buildings to be occupied by a division of approximately 17,000 men⁷ cover 1 square mile. It is estimated by the National Lumber Manufacturers Association that 1,500 feet of lumber are required for each enlisted man housed in barracks and 825 feet of lumber for each man housed in a tent camp. The whole program will use about 4-1/2 billion feet of lumber. This includes 1-1/2 billion feet for industry housing, 1 billion feet for crating, and 1/2 billion feet for the Navy.⁸

Efficient defense means efficient workmen behind the lines as well as at the front. Efficient workmen, in turn, mean living quarters that meet modern American standards. The War Department⁹ estimates that at least 7 men are needed in war industries for every soldier on the firing line. To house the workmen needed at our shipyards alone will, according to the National Defense Advisory Commission, require 42,000 new housing units; the Navy needs about 65,000 houses. The foregoing figures do not include housing for workers in Army and Navy armament factories yet to be built. The houses are to be erected by private builders, using public funds¹⁰. It is reassuring to know that officials are disposed to use lumber so far as is possible for this construction.

Wood is particularly well suited to hangars in wartime due to the speed of erection and mainly with unskilled labor, thus releasing the skilled artisans for other important wartime production duties. One of the largest hangars for the R.A.F. in Great Britain is reported to have just been completed, having been constructed of timber. The area of the roof of this hangar is more than 70,000 square feet.¹¹

⁶Eng. News Record, p. 43, Oct. 1940.

⁷Teesdale, L. V., Notes on Cantonment Plans.

⁸Amer. Lbrman., p. 40, Oct. 5, 1940.

⁹Maj. M. E. Barker, U. S. Chem. Warfare Service, p. 463, Chem. & Met. Eng. July 1940.

¹⁰Charles F. Palmer, Coordinator, N.D.A.C., p. 29, Amer. Lbrman., Sept. 21, 1940.

¹¹Australian Timber Journal, p. 378, June-July, 1940.

Since the very life of the British navy and of her manufacturing interests depends upon the uninterrupted operation on a vast scale of the English coal mines, one of the most urgent demands of the United Kingdom at the present time is reported in the official Canada Year Book to be for mine props. Normal imports amount to more than 100 million cubic feet of wood for this purpose. About 70 percent of this formerly came from the Baltic countries, and steps are now being taken to secure large quantities in Canada and Newfoundland.¹²

Should the United States be required to fulfill her Western Hemisphere defense pledges every kind and type of seaworthy ship that can be built will be in demand; many will be of combined wood and steel. Even ships now built of steel require miles of planking for decking. From Australia comes the report¹³ that some battleships require about 500,000 board feet of lumber and certain ocean transports take about 700,000 board feet of lumber and about 300,000 square feet of plywood. Then there are the mine-sweeping vessels, high-speed subchasers, and other boats of the mosquito fleet, all of which consume large quantities of wood. A large floating target, such as used for training naval aerial bombers, takes about 200,000 board feet of timber.¹³

Approximately 90 percent of the wharves and docks of the world are constructed of timber. The British are reported to require 3,600,000 board feet of timber for dock and harbor maintenance alone.¹³

Important to shipyard engineers, military bridge builders, and all others engaged in heavy wood construction are the modern metal connectors recently devised for timber joints. Such connectors make it possible to distribute the load on the wood over a broad area, with fewer bolts than would otherwise be necessary. The net result is that wood becomes a more efficient material than ever before in the erection of great engineering structures.

Air-Raid Precautions

In the event of United States entry in the war, the recent research in impregnating wood with fire-retardant chemicals will, no doubt, come into use for protecting Navy yards, hangars, and other wooden shelters from incendiary bombs. An interesting new wood use is for blackout shutters which permit ventilation yet prevent light leakage. A combination shutter of sheet steel over plywood is also reported as being used in England for bomb splinter protection of windows in city factories and buildings.¹³

¹²Canada Year Book 1940.

¹³J. M. Gosper, Director, Timber Development Assn. of Australia, Australian Timber Journal, p. 355, June-July, 1940.

Timber and sand are used on the top floor of buildings as protection against bombs of the thermite variety. A new type of paint containing borax, developed by the Forest Products Laboratory for prevention of the spread of flame on timber, is of special interest for protection against incendiary bombs. After an air raid, timber is, of course, required for bracing walls of buildings that have been hit and if left would create a public hazard. A special concession has now been made in England to occupants and owners of houses whose premises have been damaged in air raids, whereby they can obtain timber up to the value of \$25 on declaring that such timber will only be used to repair such damage.¹⁴

Containers

Boxes and crates, whether of fiberboard, veneer, or wood, absorb great quantities of forest products. Already in Great Britain, for example, 3,500,000 boxes for small arms ammunition, 1 million cordite boxes, 10 million boxes for canned food, and 1 million cases of bacon are reported to have been ordered. Cases are also required for instruments such as range finders, sextants, and the like. Crates for airplanes and airplane engines utilize great quantities of timber.

During war cargo space is at a premium. It is essential that as little room as possible be taken up by the containers, and yet they must be strong enough to protect their contents against rough handling -- particularly munition shipments. The Forest Products Laboratory is helping in many ways in the design of containers for war commodities. To cite an example, the Laboratory was recently called on to redesign a wooden container for the shipment of bombs. The redesigned container employs aspen instead of the more expensive white pine, requires less cargo space, less lumber, less weight, yet has greater strength than the original container.

Pulp and Paper and Other Chemical Products

Before the current war in Europe 30 percent of our wood pulp and 78 percent of our newsprint were imported. In this era of world-wide struggle for raw materials it is of great importance to our national defense that research to increase species utilization and develop high yield processes has advanced to a point where today the United States has the species to supply its own pulp and paper needs. Moreover, wood, in the form of pulp, may prove an important element in further improving our trade relations with South America.

Of particular significance to the international pulp situation is the fact that research has produced a high-yield semichemical pulping

¹⁴Wood, p. 237, Oct. 1940.

process that permits the use of weed hardwood species as an important component in newsprint paper which at present uses the more valuable softwood species exclusively. The process is also applicable to low-cost container boards and by a new laboratory technique to an exceptionally high yield and high quality alpha cellulose which has possibilities of direct nitration into explosives.

It is extremely difficult in our defense planning to estimate well in advance our military needs for chemical commodities. In the event of need, however, alcohol, acetone, acetic acid, mannitol, sorbitol, glucose, and various other essential war chemicals can be produced from wood.

Wood in Aircraft

Foremost on the United States national defense program are airplanes -- maybe fifty thousand of them by the spring of 1944.¹⁵

Although there has been a shift to metal aircraft in recent years, the present war emergency is again bringing a demand for wood. Outstanding needs seem to be for spruce for wing spars and plywood for the covering of fuselages and wings in training planes; also for a sheet material adapted to molding or pressing-to-form which would enable all, or parts, of fuselages or wings to be molded in mass production operations; and for an improved laminated, compressed, wooden propeller of light weight to meet the requirements of increased engine horsepower.

England has maintained her fighting air fleets successfully, against all odds, by her extensive use of laminated spruce construction.¹⁶ At present wood spars and other framing members with plywood covering are used in the wings and fuselage of military trainers in the United States. Indications are that this use will increase.

A recent survey by the Forest Products Laboratory disclosed widespread interest on the part of the Army, Navy, and aircraft manufacturers, in methods of molding plywood under fluid pressure into skins of acceptable weight that will be secure against the wrinkling and buckling to which metals are subject. Such skins, which can be varied from one part of the surface to another in accordance with strength requirements, will form a shell that has high efficiency both aerodynamically and structurally and will require only light framing members to support it. Although this molding process is still in the experimental stage, rapid development is expected.

¹⁵Mech. Eng., p. 683, Sept. 1940.

¹⁶Col. W. B. Greeley, Amer. Librarian, p. 36, Dec. 28, 1940.

This type of construction will lessen the need for wood of the near perfect character required for spars. It should make possible the utilization of veneers of many species not now considered for airplane use and should broaden the base for raw material supply as well as make supplies of wood available in every forest region.

A new synthetic resin treatment of wood developed at the Forest Products Laboratory offers important possibilities for such exacting uses as airplane wings, fuselages, and other surface parts. The treatment consists of impregnating and plasticizing the cell wall structure of veneer with synthetic resin-forming chemicals from which can be made, at low pressures, a highly compressed laminated wood with high mechanical properties, moldable to double curvature, and with an extremely smooth surface, and a high resistance to swelling and shrinking.

This synthetic resin treatment may also prove especially applicable to propeller construction. It offers the possibility with low pressures and in one pressing operation of controlling the density as desired from hub to tip and gives practically a moistureproof, nonshrink product. German and English propellers are being constructed with most of the blade of laminated, lightweight, uncompressed wood, and the hub section of compressed, laminated wood bonded with phenolic-resin glue.

National Defense Needs for Further Research

Five years ago, in July 1935, Wheeler McMillen, President of the National Farm Chemurgic Council, defined the role of research in national defense in the following words:¹⁷

"From the standpoint of national defense, the clear objective of research should be to make provision for the production, at some cost, from some domestic source, of every item that it is anticipated may ever be required for the use of our defensive forces; and, further, of every item of domestic need that might be shut off by the incident of foreign wars in which this country may not be engaged.

"Department of Agriculture research projects which clearly contribute to these ends should, therefore, be worthy of consideration by the Congress."

Past experience has clearly demonstrated that technologic and research work are critically essential to the efficient use and adaptation of wood for defense purposes on both the combat and economic fronts.

Important problems confronting the maximum efficiency of aircraft production which relate to the present and possible future use of wood, plywood, and other forest products are the development of fuselages, wings,

¹⁷Agricultural Engineering (Vol. 21, No. 7), July 1940.

and other parts, in whole or in part, by mass production molding or pressing; development of an improved, high-strength, light-weight propeller of variable density from laminated, compregnated wood for the high-powered motors that are increasingly in demand; satisfactory bonding of plywood to wing ribs or other elements of training planes by means of cold-setting resin glues; assurance of an adequate supply of spruce lumber for aircraft wing spars; determination of the basic properties of plywood as an engineering material; development of a glueable water-resistant coating for interior surfaces of wood wings or hollow wing spars; development of paints and varnish finishes that will impart a smooth and durable surface to the exposed wooden parts of airplanes; determination of the characteristics of wood construction, including acceptable repair methods for various types of structure, bolt spacings, and stress concentrations; and the development and testings of various glues and gluing techniques.

Other defense problems which either are or may become critical as the Nation's defense effort gathers momentum include the faster drying of walnut gunstock blanks and other items for special requirements; finding a suitable substitute for East Indian teak for battleship decking and for gunmount bases; developing an improved plywood, such as compreg, for planking and decking for assault boats, subchasers, and similar craft; increasing the supply of pontoon timbers and planking through the development of chemical seasoning methods and the broadening of the specifications for this stock; providing adequate protection against decay for wood boat frames and other parts; the further improvement of wood gas-mask charcoal; special paints, coatings, and other fire retardants for hangars and other critical structures; improvement of designs and specifications for shipping containers of all kinds for specific military commodities; production of essential wood chemicals; a good domestic substitute for cork and kapok is needed; and finally wood process specifications for many articles and structures need to be critically examined, revised, and geared to the present emergency conditions of stocks, supplies, and special needs.

In national defense housing there is an increasing need for engineering data on the strength and design of both permanent and emergency wood structures, especially on modern connectors and other joints and fastenings, glued-up laminated structural members, and prefabrication of houses for speedy erection at the site; also on seasoning, grading, and selection of lumber for rapid construction; moisture control in barracks and houses to prevent condensation; and protection against decay, weathering, and fire.

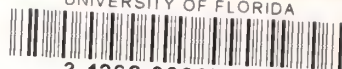
On the economic front, the possibility of developing a large pulp and paper market in Central and South America and the possibility of having to meet our own needs with our own forest resources both suggest the need of further broadening the species base of our paper industry to fullest extent, as well as enlarging the number of kinds of paper made from our own woods.

Possibilities of expanding the plywood industry within our own country and of increasing our export business with Central and South

America are great. But in order to do so the raw material base of the industry must be broadened. Methods of treating various woods prior to cutting them into veneer and improved veneer cutting and plywood manufacturing methods must be developed and grades and yields determined for species of wood other than Douglas-fir and for logs of lower quality than are now used.

Here in the United States, every individual, every organization, and every resource is expected to contribute the utmost toward the national defense of our country. The individuals are willing, the organizations already exist, and the resources, including forests among those of major importance, are bountiful. This combination, aided by research, can build a strong and secure national defense on both the combat and economic fronts. All that is required is the "green light."

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